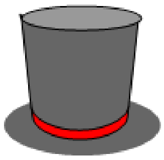
4.1: Translations

Essential Question

How can you translate a figure in a coordinate plane?

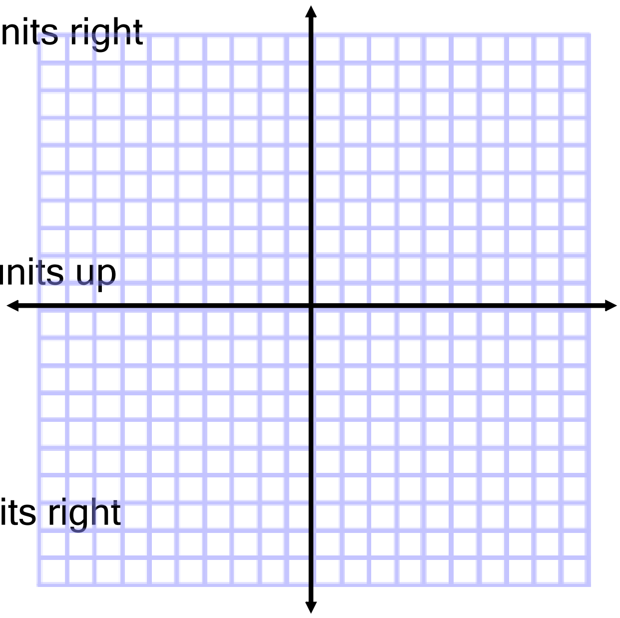


Translate point P. State the coordinates of P'.

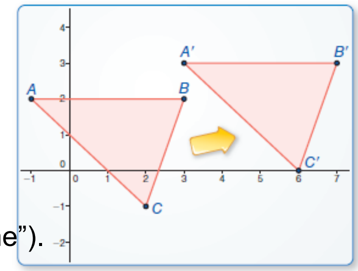
1. P(−4, 4); 2 units down, 2 units right

2. P(−3, −2); 3 units right, 3 units up

3. P(2, 2); 2 units down, 2 units right



Work with a partner.



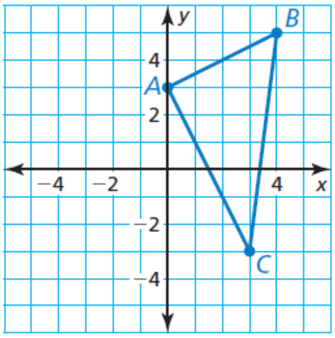
a. Use dynamic geometry software to draw any triangle and label it $\triangle ABC$.

b. Copy the triangle and *translate* (or slide) it to form a new figure, called an *image*, $\triangle A'B'C'$ (read as "triangle *A* prime, *B* prime, *C* prime").

c. What is the relationship between the coordinates of the vertices of $\triangle ABC$ and those of $\triangle A'B'C'$?

d. What do you observe about the side lengths and angle measures of the two triangles?

Work with a partner.



a. Translate your triangle either left or right, and up or down. Describe this change in the table below.

b. Write down the coordinate rule for this transformation in the table.

c. Write down the transformation vector in the table.

d. Are its side lengths the same as those of $\triangle ABC$?

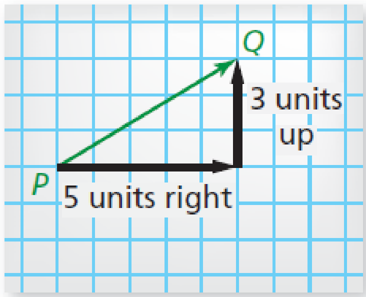
e. Repeat this for 3 more transformations.

Lt/Rt distance	Up/Dn distance	Coordinate Rule	Vector
		$(x, y) \rightarrow ($, $)$	
		$(x, y) \rightarrow ($, $)$	
		$(x, y) \rightarrow ($, $)$	
		$(x, y) \rightarrow ($, $)$	

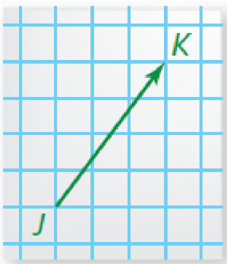
Core Concept

Vectors

The diagram shows a vector. The **initial point**, or starting point, of the vector is P, and the **terminal point**, or ending point, is Q. The vector is named $\overrightarrow{PQ}$, which is read as "vector PQ." The **horizontal component** of $\overrightarrow{PQ}$ is 5, and the **vertical component** is 3. The **component form** of a vector combines the horizontal and vertical components. So, the component form of $\overrightarrow{PQ}$ is $\langle 5, 3 \rangle$.



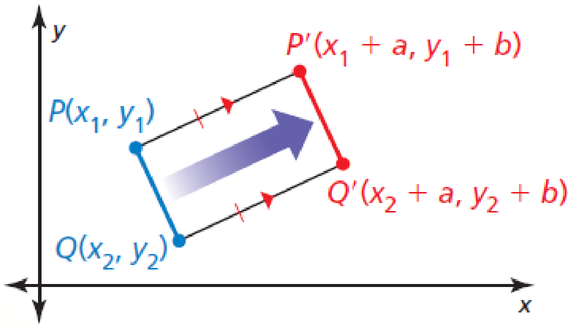
In the diagram, name the vector and write its component form.



Core Concept

Translations

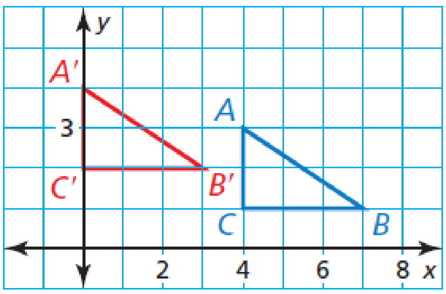
A **translation** moves every point of a figure the same distance in the same direction. More specifically, a translation *maps*, or moves, the points P and Q of a plane figure along a vector $\langle a, b \rangle$ to the points P' and Q', so that one of the following statements is true.



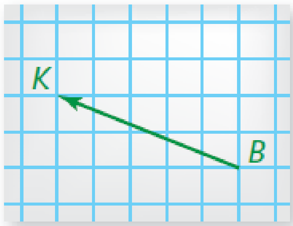
- $PP' = QQ'$ and $\overline{PP'} \parallel \overline{QQ'}$, or
- $PP' = QQ'$ and $\overline{PP'}$ and $\overline{QQ'}$ are collinear.

The vertices of $\triangle ABC$ are $A(0, 3)$, $B(2, 4)$, and C(1, 0). Translate $\triangle ABC$ using the vector $\langle 5, -1 \rangle$.

Write a rule for the translation of $\triangle ABC$ to $\triangle A'B'C'$.



1. Name the vector and write its component form.



2. The vertices of △*LMN* are *L*(2, 2), *M*(5, 3), and *N*(9, 1). Translate △*LMN* usingthe vector ⟨−2, 6⟩.

3. In Example 3, write a rule to translate △*A′B′C′* back to △*ABC*.

4. Graph △*RST* with vertices *R*(2, 2), *S*(5, 2), and *T*(3, 5) and its image after the translation $(x, y) \rightarrow (x + 1, y + 2)$.

Postulate

Postulate 4.1 Translation Postulate

A translation is a rigid motion.

Theorem

Theorem 4.1 Composition Theorem

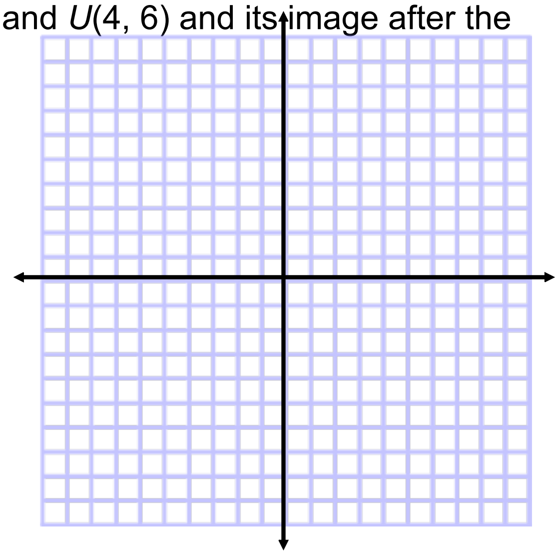
The composition of two (or more) rigid motions is a rigid motion.

Proof Ex. 35, p. 180

5. Graph $\overline{TU}$ with endpoints $T(1, 2)$ and $U(4, 6)$ and its image after the composition.

Translation: $(x, y) \rightarrow (x - 2, y - 3)$

Translation: $(x, y) \rightarrow (x - 4, y + 5)$



6. Graph $\overline{VW}$ with endpoints $V(-6, -4)$ and $W(-3, 1)$ and its image after the composition.

Translation: $(x, y) \rightarrow (x + 3, y + 1)$

Translation: $(x, y) \rightarrow (x - 6, y - 4)$